

# LG vs. Samsung Smart TV: Which Is Better for Tracking You?

SANE(Security Analysis aNd Evaluation) Lab

Korea University(高麗大學校)

Sangmin Lee, Minsu Park, Seungjoo Kim

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# Who are we?

## Sangmin Lee (李相旼)

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Sangmin Lee is a master student of SANE(Security Analysis aNd Evaluation) Lab on CIST(Center for Information Security Technologies) at Korea University. He is most interested in offensive security about system vulnerabilities and is interested in fields such as digital forensics, security assessment, and software testing. Also, he participated in projects such as "Security Testing for External Interfaces of Vehicular Wireless Systems", "Cyber Fast Track related to IoT devices vulnerabilities analysis" and "WebOS smart TV international security CC(Common Criteria) certification acquisition." In 2015, he participated as a mentee at BoB(Best of the Best), an information security leader training program hosted by KITRI(Korea Information Technology Research Institute). He, in BoB, conducted a project to analyze vulnerabilities in embedded devices such as routers, IP cameras, Smart home, and SCADA. Also, he presented the project results at POC(Power Of Community) 2015 on the subject of "What if Fire Sale occurs in Korea?"



# Who are we?

## Minsu Park (朴珉洙)

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Minsu Park received his B.S degree in Computer Network from Silla University of Korea, in 2010 and also received his M.S degree in Information Security from Korea University of Korea, in 2013. He is currently working toward the Ph.D. degree in Information Security, Korea University, Korea. His research interests include Information Assurance, IoT Security, Digital Forensics and Usable Security.



## Seungjoo Gabriel Kim\* (金昇柱)

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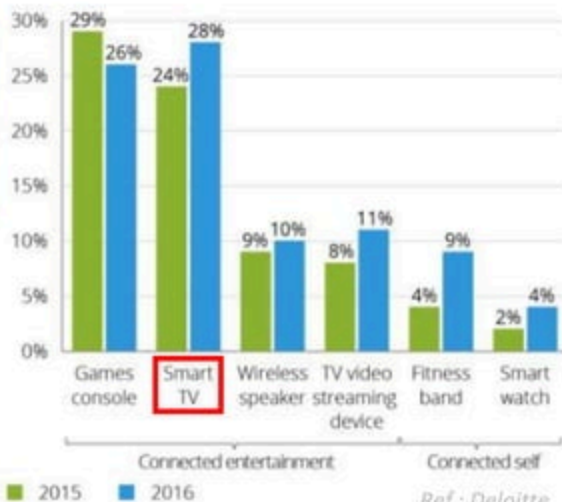
Homepage : www.kimlab.net

Facebook, Twitter : @skim71

Prof. Seungjoo Gabriel Kim is a full professor of Undergraduate Department of Cyber Defense / Graduate School of Information Security in Korea University, a member of CIST(Center for Information Security Technologies) of Korea University, a vice-director of CW-TEC(Cyber Weapon Test and Evaluation Center) of Korea University, a head of SANE(Security Analysis aNd Evaluation) Lab, an advisor of 'CyKor'(Cyber security club at Korea university), a founder/advisory director of a hacker group, 'HARU' and an international security & hacking conference, 'SECUINSIDE'. Prior to joining a tenure-track faculty member at Korea University in 2011, he was previously an Assistant & Associate Professor of School of Information and Communication Engineering in Sungkyunkwan University for 7 years ('04~'11). Before that, he worked as a Team Leader of Cryptographic Technology Team and (CC-based) IT Security Evaluation Team of KISA(Korea Internet & Security Agency) for 5 years ('98~'04). He received his B.S. ('94), M.S. ('96), and Ph.D. ('99) in Information Engineering from Sungkyunkwan University, Korea.



# The History of Digital Forensics on Smart TV



Ref : Deloitte

# The History of Digital Forensics on Smart TV

*"That Time Cops Searched A Samsung Smart TV For Evidence Of Child Abuse"*

- US Forbes magazine in 2017.

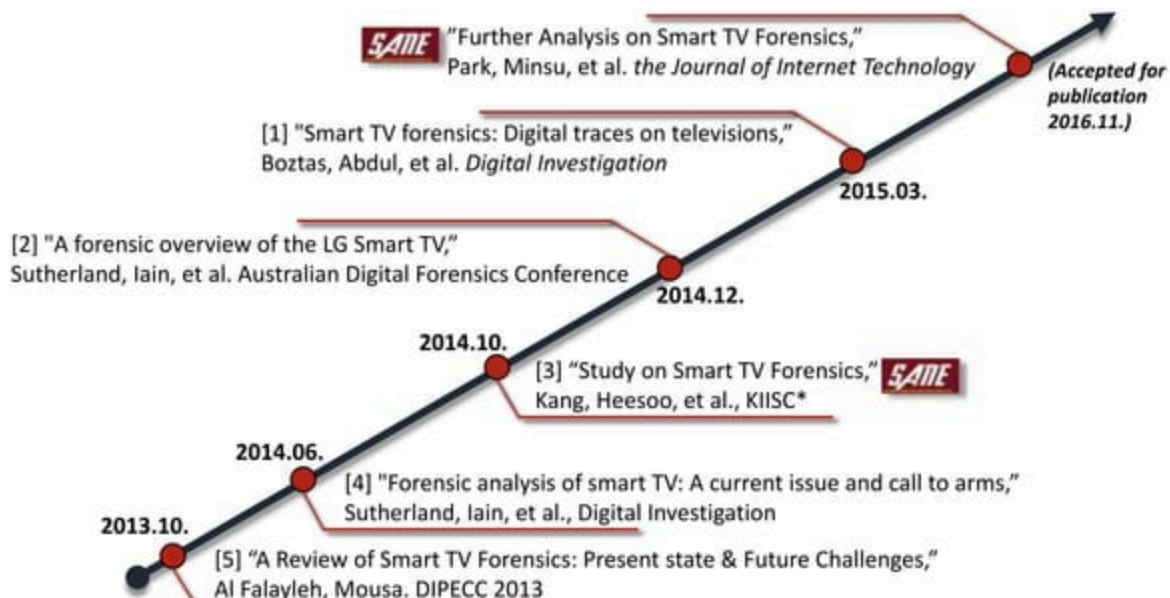
It occurred in June 2016, when San Diego officers working for the Homeland Security Investigations (HSI) unit sought information from the Samsung smart TV of Mikhail Feldman, a man previously convicted for possession of "images of minors engaged in sexually explicit conduct," as outlined in an affidavit for

16 7. Probation officers also found several items of contraband and evidence of  
17 conduct violating the terms of Feldman's supervised release. These items include  
18 a Samsung Smart Television (with internet access), Model: UN46F6350AF,  
19 Serial No: Z6PR3CVDA03513D; a Toshiba Satellite laptop, Model: PSAFGU-

▲ it appears to be the first ever published warrant for a smart TV

# The History of Digital Forensics on Smart TV

## Related works on Smart TV Forensics

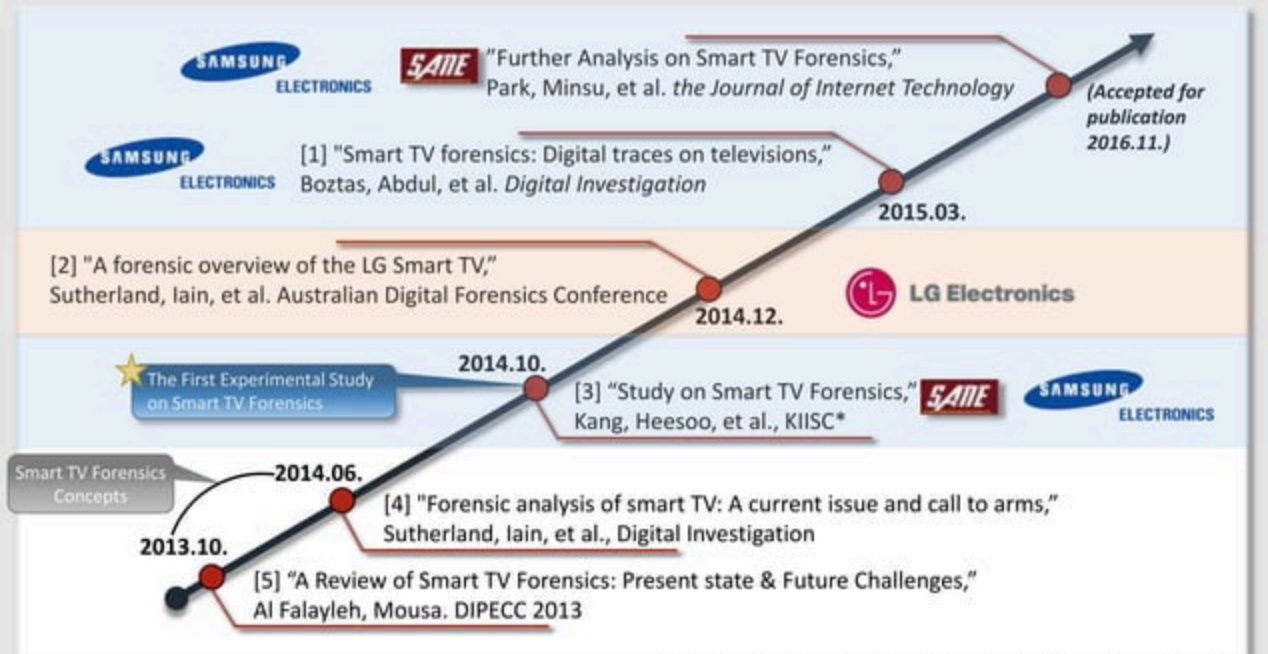


\*KIISC : Korea Institute of Information Security & Cryptology



# The History of Digital Forensics on Smart TV

## Related works on Smart TV Forensics



\*KIISC : Korea Institute of Information Security & Cryptology



# The History of Digital Forensics on Smart TV



[5] "A Review of Smart TV Forensics: Present state & Future Challenges,"  
Al Falayleh, Mousa., DIPECC 2013

## (1) Digital evidences on the Smart TV



## (2) Challenges facing the Smart TV forensics

- Currently, Smart TV is continuously developed
- Can't use existing forensics tools on the Smart TV

[4] "Forensic analysis of smart TV: A current issue and call to arms,"  
Sutherland, Iain, et al., Digital Investigation

## (1) Data acquisition method on the Smart TV

Smart TV uses the  
soldered storage device



1. Relevant digital clues
2. Universality of methods and techniques
3. The availability of assistance from the industry
4. The need for specialist knowledge or equipment

# The History of Digital Forensics on Smart TV

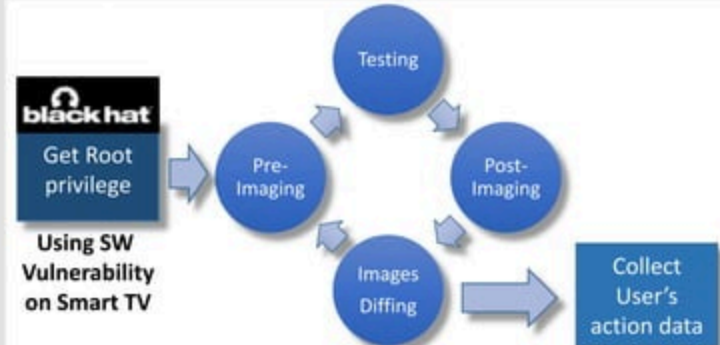


## Target



Samsung  
UN46ES8000(2012)

## Analysis Process



-> Collecting 9 User's Action Data on Features of TV & Applications

# The History of Digital Forensics on Smart TV



## Target



LG  
42LS570T-ZB(2012)



LG  
55LA740V(2013)

## Analysis Process



-> Collecting 10 User's Action Data on TV & Applications Menu  
(e.g. Recent History : *My Apps* -> *Home* -> *Recent*)

# The History of Digital Forensics on Smart TV

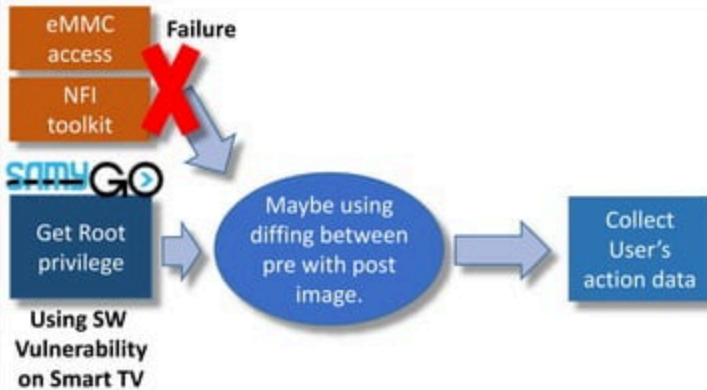


## Target



Samsung  
UE40F7000SLXXN(2013)

## Analysis Process



-> Collecting about 8 User's Action Data on Features of TV & Applications

# The History of Digital Forensics on Smart TV



Target

Compare with the previous studies



Samsung  
UN46ES8000(2012)

VS.



2014. 12.  
[2] I. Sutherland



VS.



2015. 03.  
[1] A. Boztas



# The History of Digital Forensics on Smart TV

	TV Forensics Concepts		LG Smart TV	Samsung Smart TV		
	M Al Falayleh [5]	I.Sutherland [4]	I.Sutherland [2]	H.S.Kang [3]	A.Boztas [1]	M.S.Park
Issue Year	2013	2014	2014	2014 	2015	2016 
Published	DIPECC 2013	Digital Investigation	Australian digital forensics confer	KIISC*	Digital Investigation	The journal of Internet Technology
Target	-	-	42LS570T-ZB, 55LA740V	UN46ES8000	UE40F7000SLXXN	UN46ES8000
TV's Release Year	-	-	2012, 2013	2012	2013	2012
OS	-	-	webOS 2.0	Proprietary OS	Proprietary OS	Proprietary OS
Data Acquisition Method	-	-	Failed to acquire data	Software Vulnerability (1-day vuln)	Software Vulnerability (1-day vuln)	Software Vulnerability (1-day vuln)
Analysis Procedure	-	-	Using only TV's functions(config menu, app info)	(1) Disk Imaging (2) Diffing	(It's guessed in the same way as us)	(1) Disk Imaging (2) Diffing

\*KIISC : Korea Institute of Information Security & Cryptology



# The History of Digital Forensics on Smart TV

## Smart TV Hacking

### LG Smart TV

#### Hack In Paris 2017

"Are you watching TV now? Is It real?: Hacking of smart TV with 0-day"



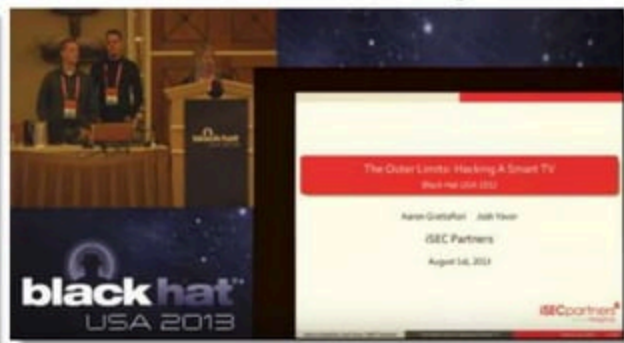
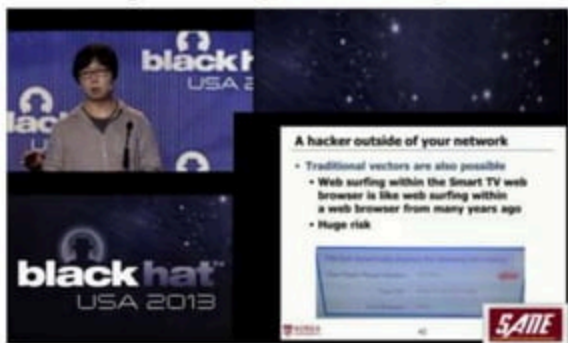
# The History of Digital Forensics on Smart TV

## Smart TV Hacking

### Samsung Smart TV

Black Hat USA 2013

▼ "Hacking, Surveilling, and deceiving victims on Smart TV" ▼ "The Outer Limits: Hacking A Smart TV"



Online community on the Samsung TV Firmware ►



# The History of Digital Forensics on Smart TV

## Common Criteria on the Smart TV

### LG Smart TV

#### Study a PP(Protection Profile) for Smart TV (2014)



## Developing a PP for Smart TV

ICCC 2014

Security Analysis and Evaluation(SANE) Lab.

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CIST (Center for Information Security Technologies), Korea University

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### LG Smart TV

#### How to obtain CC Certification of Smart TV (2017)

## How to Obtain Common Criteria Certification of Smart TV for Home IoT Security and Reliability

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Hwang518@gmail.com  
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**Abstract:** In the new era of IoT (Internet of Things), numerous gadgets and services include innovative IoT technologies that provide customers with convenience and improve their quality of life. Smart TVs are typical IoT devices that offer broadcasting services. However, they are susceptible to security intrusions via e-mail, media players, cameras, and internet connectivity. The frequency of hacking through malicious applications installed in Smart TV has rapidly increased. Therefore, appropriate countermeasures should be developed immediately. In April 2017, we (with LG electronics) received the 'world-first' Common Criteria EAL2 (Evaluation Assurance Level 2) certification for Smart TVs. As far as we know, no Smart TV has received a Common Criteria EAL2 security certification until now. This article describes our experience with the certification process and examines several security and reliability aspects of Smart TVs.

**Keywords:** IoT (Internet of Things); Smart TV; Common Criteria; security; reliability

# The History of Digital Forensics on Smart TV

## Common Criteria on the Smart TV

### LG Smart TV

#### LG Smart TV Application Security Solution (received CC EAL2 certification)



### Samsung Smart TV

#### Samsung Smart TV Security Solution (received CC EAL1 certification)



# LG webOS 3.0 Smart TV Forensics

- Data Acquisition
- File System & Data Analysis
- Collect LG Smart TV's digital evidences

# Target - LG webOS 3.0 Smart TV



- Model : 43UH6810
- OS : webOS 3.0
- Firmware : 4.30.85 (17.04.19)  
(Latest version is updated on 17.10.28)



# Target - LG webOS 3.0 Smart TV

## What is webOS?



- webOS is a mobile operating system acquired by HP for use in various products manufactured by LG.
- LG announces products that use webOS at CES every year.
- Currently, Smart TV, SmartWatch(Urbane), and Refrigerator produced in LG have used the webOS.

# LG webOS 3.0 Smart TV Forensics

- **Data Acquisition**
- File System & Data Analysis
- Collect LG Smart TV's digital evidences

# Data Acquisition

## Invasive Physical Data Acquisition

- But, Smart TV uses soldered storage devices & Disable JTAG, UART port



⇒ **laborious work**

(In general, Smart TV's cost over \$1000.)

⇒ Data Acquisition through application vulnerabilities

# Data Acquisition

Using application vulnerability to acquire data

Obtain accessible  
privilege to filesystem

Unknown Vulnerabilities (0-day)



\$ gdb



Known Vulnerabilities (1-day)



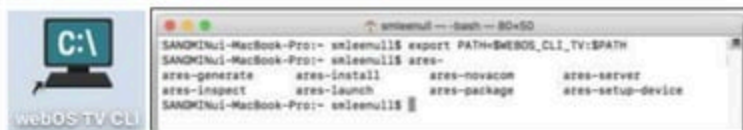
# Data Acquisition

## Hack In Paris 2017 – LG webOS Smart TV's 0-day

"Are you watching TV now? Is It real?: Hacking of smart TV with 0-day"



## Attack Vector



### • webOS emulator for developers

- 1) Connect to TV's SSH services
- 2) Remote app installation on TV
- 3) Remote app execution
- 4) ...

# Data Acquisition

## Connection to TV through SSH

```
SANGMINui-MacBook-Pro:~ smleenull$ export PATH=$WEBOS_CLI_TV:$PATH
SANGMINui-MacBook-Pro:~ smleenull$ ares-novacom -d tv1 -r "sh"
id
uid=6811(prisoner) gid=5000 groups=29(audio),44(video),505(compositor),509(se),777(c
rashd)
ls -al
total 40
drwxrwxrwx    4 root      root           4096 Nov  7 18:28 .
dr-xr-xr-x    5 prisoner  5000         4096 Jul 13 01:10 ..
drwxrwxrwx    2 develop  develop    4096 Oct 31 14:13 .ssh
drwxrwxrwx    3 root      root       4096 Oct 31 14:29 apps
prwxrwxrwx    1 prisoner  5000           0 Nov  7 18:17 backpipe
-rwxrwxrwx    1 prisoner  5000          87 Oct 31 14:22 cmd
-rwxrwxrwx    1 5839      5000       13195 Oct 31 14:13 jail_app.conf
-rwxrwxrwx    1 5839      5000       1631 Oct 31 14:13 jail_app.conf.sig
lrwxrwxrwx    1 root      root        18 Oct 31 14:13 log -> /tmp/developer/log
mount
mount | wc -l
0
```



# Data Acquisition

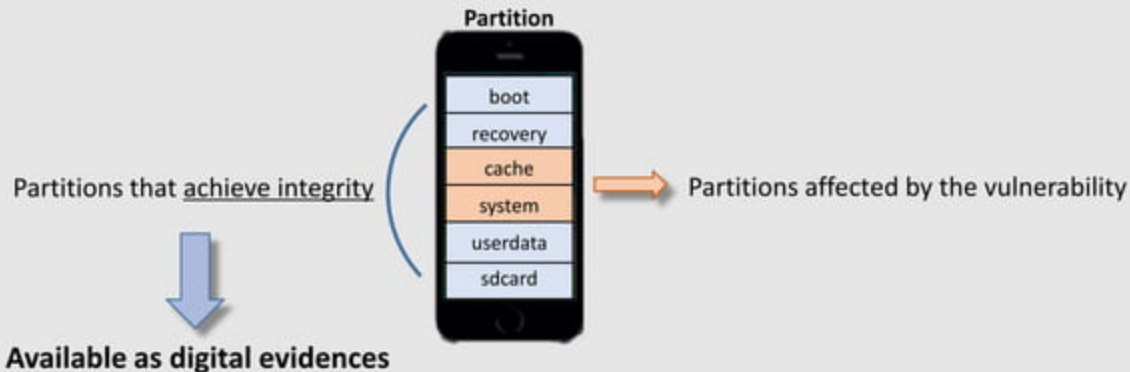
## Obtain root privilege with Command Injection

```
smleenu@smleenu-virtual-machine:~$ nc -nvlp 31337
Listening on [0.0.0.0] (family 0, port 31337)
Connection from [192.168.0.12] port 31337 [tcp/*] accepted (family 2, sport 48736)
id
uid=0(root) gid=0(root) groups=0(root),10(wheel),506(pulse-access),509(se),777(crashd)
id
uid=0(root) gid=0(root) groups=0(root),10(wheel),506(pulse-access),509(se),777(crashd)
mount | wc -l
115
```

# Data Acquisition

How can achieve the integrity of original data when data is acquired via rooting?

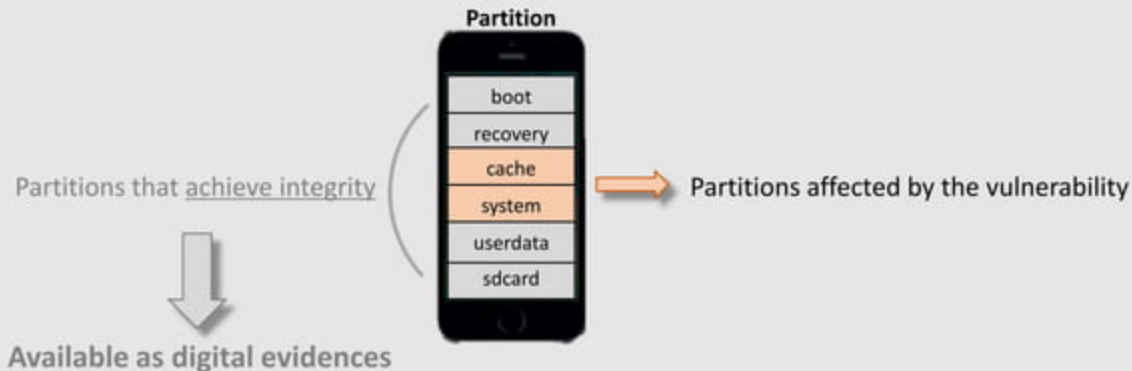
e.g. Smartphone's Digital Forensics



# Data Acquisition

How can achieve the integrity of original data when data is acquired via rooting?

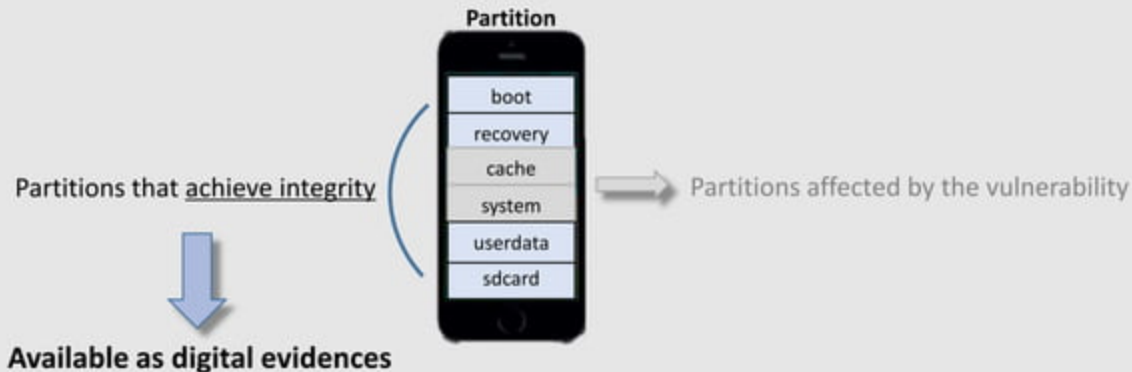
e.g. Smartphone's Digital Forensics



# Data Acquisition

How can achieve the integrity of original data when data is acquired via rooting?

e.g. Smartphone's Digital Forensics



# Data Acquisition

How can achieve the integrity of original data when data is acquired via rooting?

In case of Smart TV,

- ① The use of partitions is ambiguous. Therefore, the vulnerability affects most partitions.  
(It is corresponding to not only our study but also existing studies)
- ② Integrity can be considered on a folder-by-folder basis, not a partition.

*So, I think...*

*as in the case of the United States, there will be a social debate on using a vulnerability to acquire original data against smart TV as the need for smart TV forensics increases.*



# LG webOS 3.0 Smart TV Forensics

- Data Acquisition
- **File System & Data Analysis**
- Collect LG Smart TV's digital evidences

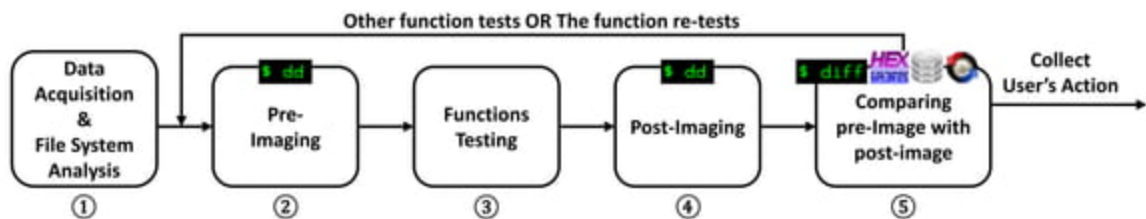


# Data Analysis – File System

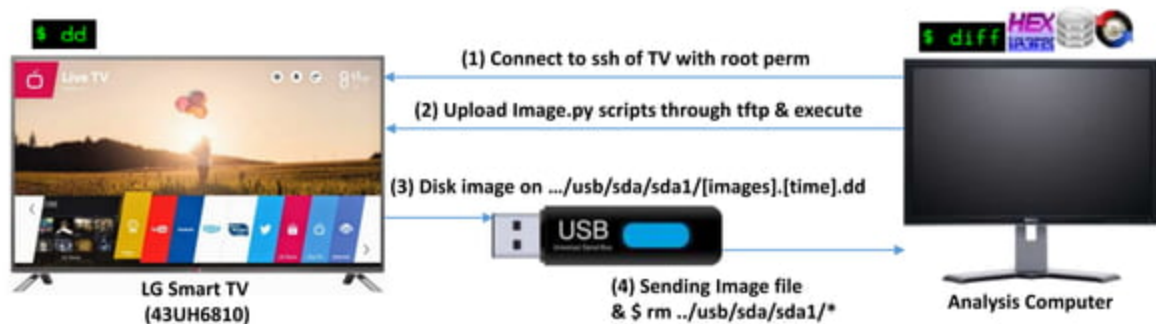
Partition	Path	File system
/dev/mmcblk0p15 ~ /dev/mmcblk0p35	-	-
/dev/mmcblk0p50	/mnt/lg/db8	ext4
	/var/db	ext4
/dev/mmcblk0p51	/home	ext4
	/mnt/lg/cmn_data	ext4
	/mnt/lg/flash/data	ext4
	/mnt/lg/user	ext4
	/var	ext4
	/mnt/lg/cache/flash	ext4
	/mnt/lg/cache/sdp	ext4
	/mnt/lg/cache/browser	ext4
	/mnt/lg/cache/webbrowser	ext4
	/var/palm/jail/com.webos.app.browser/var/luna/preferences	ext4 (read only)
	/var/palm/jail/com.webos.app.browser/mnt/lg/cache/webbrowser	ext4
	/var/palm/jail/com.webos.app.browser/mnt/lg/cmn_data/admanager/cache	ext4 (read only)
/dev/mmcblk0p52	/mnt/lg/appstore	ext4
	/media	ext4
	/var/palm/jail/com.webos.app.browser/media/internal	ext4

# Data Analysis

## Process of Data Analysis



## Smart TV's Disk Imaging Environment



## Example) Steps ② ~ ④ - Disk Imaging & Testing

### ② Pre-Imaging

이름

- ☐ before\_mmcblk0p15.2017-07-13.01\_38.dd
- ☐ before\_mmcblk0p27.2017-07-13.01\_39.dd
- ☐ before\_mmcblk0p28.2017-07-13.01\_38.dd
- ☐ before\_mmcblk0p29.2017-07-13.01\_38.dd
- ☐ before\_mmcblk0p30.2017-07-13.01\_39.dd
- ☐ before\_mmcblk0p31.2017-07-13.01\_39.dd
- ☐ before\_mmcblk0p32.2017-07-13.01\_38.dd
- ☐ before\_mmcblk0p33.2017-07-13.01\_38.dd
- ☐ before\_mmcblk0p35.2017-07-13.01\_39.dd
- ☐ before\_mmcblk0p50.2017-07-13.01\_49.dd
- ☐ before\_mmcblk0p51.2017-07-13.01\_45.dd
- ☐ before\_mmcblk0p52.2017-07-13.01\_50.dd

### ③ Functions Testing



### ④ Post-Imaging

이름

- ☐ after\_mmcblk0p15.2017-07-14.02\_48.dd
- ☐ after\_mmcblk0p27.2017-07-14.02\_49.dd
- ☐ after\_mmcblk0p28.2017-07-14.02\_47.dd
- ☐ after\_mmcblk0p29.2017-07-14.02\_47.dd
- ☐ after\_mmcblk0p30.2017-07-14.02\_49.dd
- ☐ after\_mmcblk0p31.2017-07-14.02\_49.dd
- ☐ after\_mmcblk0p32.2017-07-14.02\_48.dd
- ☐ after\_mmcblk0p33.2017-07-14.02\_48.dd
- ☐ after\_mmcblk0p35.2017-07-14.02\_49.dd
- ☐ after\_mmcblk0p50.2017-07-14.03\_00.dd
- ☐ after\_mmcblk0p51.2017-07-14.02\_55.dd
- ☐ after\_mmcblk0p52.2017-07-14.03\_00.dd

# Data Analysis

## Example) Step ⑤ - Compare Pre-Image with Post-Image (diffing)

- (1) \$ diff -rNd ~/pre\_image ~/post\_image
- (2) Using Beyond Compare, Windump to binary diffing

```
smleenui — smleenui@smleenui-virtual-machine: ~/Disk_Imaging/[result]first_vs_third — ssh 192.168.0.5 — 101x23
diff -rNd /home/smleenui/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.eim.setting.cache.md5 /home/smleenui/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.eim.setting.cache.md5
1c1
< 2df3384aabdd8cb7dad8629e3030cf5c /var/com.webos.service.eim.setting.cache
—
> 2afdc519f0579e66e27403a1953e574c /var/com.webos.service.eim.setting.cache
Binary files /home/smleenui/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.pdm.cache and /home/smleenui/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.pdm.cache differ
diff -rNd /home/smleenui/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.pdm.cache.md5 /home/smleenui/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.pdm.cache.md5
1c1
< 7c39e8d1859432a7d2a3db4a73ad9951 /var/com.webos.service.pdm.cache
—
> f144f75f554f1f4546d59ba7f3b41e81 /var/com.webos.service.pdm.cache
Binary files /home/smleenui/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.sdx.cache and /home/smleenui/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.sdx.cache differ
diff -rNd /home/smleenui/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.sdx.cache.md5 /home/smleenui/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.sdx.cache.md5
1c1
< 7e26d5cea089ff2f9ecf402c4e5198e8 /var/com.webos.service.sdx.cache
—
> 4b58d12be8d2a5915901a9a0cf8c543f /var/com.webos.service.sdx.cache
```

50,1 0%

# Data Analysis

## Example) Step ⑤ - Compare Pre-Image with Post-Image (diffing)

(1) \$ diff -rNd ~/pre\_image ~/post\_image

(2) Using Beyond Compare, WinHex to binary diffing

```
diff -rNd /home/smleenuull/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.eim.setting.cache.md5  
/home/smleenuull/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.eim.setting.cache.md5
```

1c1

```
< 2df3384aabbdd0cb7dad8629e3030cf5c /var/com.webos.service.eim.setting.cache
```

Plain Text File

```
> 2afdc519f0579e66e27403a1953e574c /var/com.webos.service.eim.setting.cache
```

```
/smleenuull/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.pdm.cache differ  
diff -rNd /home/smleenuull/Disk_Imaging/before/mmcblk0p51/var/com.webos.service.pdm.cache.md5 /home/sm  
leenuull/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.pdm.cache.md5
```

1c1

```
< 7c39e8d1859432a7d2a3db4a73ad9951 /var/com.webos.service.pdm.cache
```

```
> f144f75f554f1f4546d59ba7f3b41e81 /var/com.webos.service.pdm.cache
```

Binary files /home/smleenuull/Disk\_Imaging/before/mmcblk0p51/var/com.webos.service.sdx.cache and /home  
/smleenuull/Disk\_Imaging/after/mmcblk0p51/var/com.webos.service.sdx.cache differ

Binary File

```
leenuull/Disk_Imaging/after/mmcblk0p51/var/com.webos.service.sdx.cache.md5
```

1c1

```
< 7e26d5cea089ff2f9ecf402c4e5198e8 /var/com.webos.service.sdx.cache
```

```
> 4b58d12be8d2a5915901a9a@cf8c543f /var/com.webos.service.sdx.cache
```

50,1

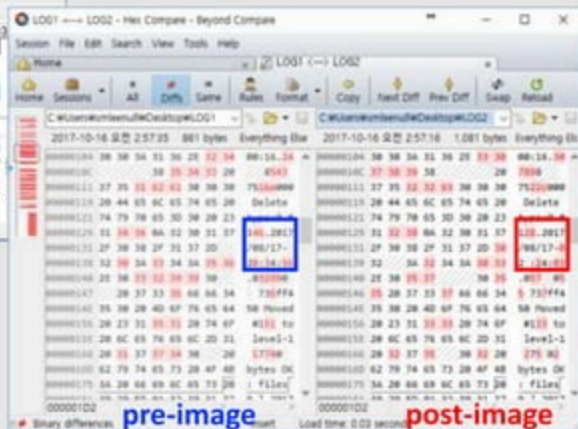
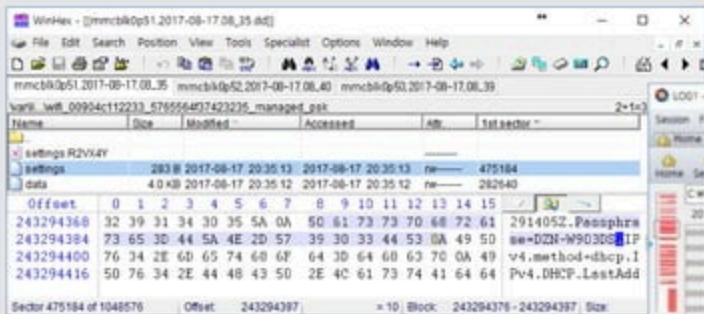
0%

# Data Analysis

## Example) Step ⑤ - Compare Pre-Image with Post-Image (diffing)

(1) \$ diff -rNd ~/pre\_image ~/post\_image

(2) Using Beyond Compare, WinHex to binary diffing





# LG webOS 3.0 Smart TV Forensics

- Data Acquisition
- File System & Data Analysis
- **Collect LG Smart TV's digital evidences**

# Collect LG Smart TV's digital evidences

## 12 User's Actions

(First check : 18 July 2017, Last check : 14 Oct 2017)

#	User's Action	Path
1	Last TV On time	/mmcbk0p50/var/db/main/LOG
2	TV Channel List	/mmcbk0p51/epg/db/PBS_OFF_DB_0_4.db /mmcbk0p51/epg/tuner_favorite_move_index.txt
3	External Storage Usage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log
4	TV ON/OFF Reservation	/mmcbk0p51/var/luna/preferences/time
5	Hardware Connection Information	/mmcbk0p51/var/lib/webappmanager3/LocalStorage/file_com.webos.app.inputmgr_0.localstorage
6	Installed App Information	/mmcbk0p52/cryptofs/apps/usr/lib/opkg/status
7	Internet History	/mmcbk0p51/webbrowser/chrome/Default/Bookmarks, Prefer*, History
8	Recently Service Usage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log
9	App Install History	/mmcbk0p51/var/luna/data/downloadhistory.db
10	Checking Captured Image	/mmcbk0p52/captureTV
11	Last time app opened	/mmcbk0p51/var/lib/webappmanager3/LocalStorage/https_kr.lgrecommends.lgappstv.com_0.localstorage
12	Connected Wifi Information	/mmcbk0p51/var/lib/connman/*

# Collect LG Smart TV's digital evidences

## 12 User's Actions

(First check : 18 July 2017, Last check : 14 Oct 2017)

#	User's Action	Path
1	Last TV On time	/mmcbk0p50/var/db/main/LOG
2	TV Channel List	/mmcbk0p51/epg/db/PBS_OFF_DB_0_4.db /mmcbk0p51/epg/tuner_favorite_move_index.txt
3	External Storage Usage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log
4	TV ON/OFF Reservation	/mmcbk0p51/var/luna/preferences/time
5	Hardware Connection Information	/mmcbk0p51/var/lib/webappmanager3/LocalStorage/file_com.webos.app.inputmgr_0.localstorage
6	Installed App Information	/mmcbk0p52/cryptofs/apps/usr/lib/opkg/status
7	Internet History	/mmcbk0p51/webbrowser/chrome/Default/Bookmarks, Prefer*, History
8	Recently Service Usage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log
9	App Install History	/mmcbk0p51/var/luna/data/downloadhistory.db
10	Checking Captured Image	/mmcbk0p52/captureTV
11	Last time app opened	/mmcbk0p51/var/lib/webappmanager3/LocalStorage/https_kr.lgrecommends.lgappstv.com_0.localstorage
12	Connected Wifi Information	/mmcbk0p51/var/lib/connman/*

# Collect LG Smart TV's digital evidences

#	User's Action	Path
1	Last TV On time	/mmcblk0p50/var/db/main/LOG

```
2016/01/01-09:00:16.210682 751ba000 Recovering log #146
2016/01/01-09:00:16.223571 751ba000 Level-0 table #151: started
2016/01/01-09:00:16.232169 751ba000 Level-0 table #151: 17740 bytes OK
2016/01/01-09:00:16.248342 751ba000 Delete type=3 #144
2016/01/01-09:00:16.248543 751ba000 Delete type=0 #146
2017/08/17-20:34:56.032990 736ff450 Moved #151 to level-1 17740 bytes OK: files[ 0 1 3 0 0 0 0 ]
2017/08/17-20:34:56.113747 736ff450 Compacting 1@1 + 3@2 files
2017/08/17-20:34:57.040067 736ff450 Generated table #153: 70940 keys, 2126081 bytes
2017/08/17-20:34:57.759568 736ff450 Generated table #154: 5205 keys, 2115066 bytes
2017/08/17-20:34:57.889791 736ff450 Generated table #155: 790 keys, 243516 bytes
2017/08/17-20:34:57.889924 736ff450 Compacted 1@1 + 3@2 files => 4484663 bytes
2017/08/17-20:34:57.909153 736ff450 compacted to: files[ 0 0 3 0 0 0 0 ]
```

# Collect LG Smart TV's digital evidences

#	User's Action	Path
3	External Storage History	/mmcblk0p52/cryptofs/data/db8/mediadb/media/*.log
8	Recently Service Usage History	/mmcblk0p52/cryptofs/data/db8/mediadb/media/*.log

```
/tmp/usb/sda/sda1/image2.jpgNUL+EOT
USB_4138453442433843NULNULSOH"ACKNULEOT
com.webos.service.cbox.image:1NULETXFFDC2EMg#?K
KJCNAWi5aF3NULNULASTXNULVT4EOT
/tmp/usb/sdb/sdb1/PSY - 'New Face' M-V.mp4NULEOT
```

# Collect LG Smart TV's digital evidences

#	User's Action	Path
3	External Storage History	/mmcblk0p52/cryptofs/data/db8/mediadb/media/*.log
8	Recently Service Usage History	/mmcblk0p52/cryptofs/data/db8/mediadb/media/*.log

```
/tmp/usb/sda/sda1/image2.jpgNUL+EOT
USB_4138453442433843NULNULSOH"ACKNUL EOT
com.webos.service.cbox.image:1NUL ETX FFDC2 EMg#?K
KJCNAWi5aF3NULNULASTXNULVT4EOT
/tmp/usb/sdb/sdb1/PSY - 'New Face' M-V.mp4NUL EOT
```

File Name that exists  
on the external storage

USB Serial Number

Unknown Strings

```
>>> S = [0x41, 0x38, 0x45, 0x34, 0x42, 0x43, 0x38, 0x43]
>>> ''.join(map(chr,S))
'A8E4BC8C'
>>>
```

USB Serial Number

## Mass Storage:

제품 ID:	0x6387
공급업체 ID:	0x058f (Alco
버전:	1.00
일련 번호: Serial Number	A8E4BC8C
속도:	최대 480Mb/초

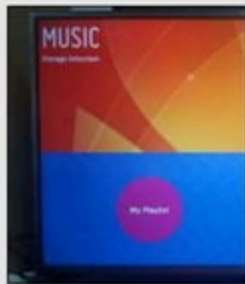
Check Serial Number on my Mac



# Collect LG Smart TV's digital evidences

#	User's Action	Path
3	External Storage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log
8	Recently Service Usage History	/mmcbk0p52/cryptofs/data/db8/mediadb/media/*.log

Vcom.webos.app.connectionwizard기기 연결/usr/palm/applications/com.webos.app.connectionwizard/assets/hd1080/deviceconnector\_splash.pngKLwL2fAayzc|  
Vcom.webos.app.music음악/usr/palm/applications/com.webos.app.music/assets/hd1080/music\_splash.pngKLwL2fAudPg?  
Vcom.webos.app.scheduler예약 목록/usr/palm/applications/com.webos.app.scheduler/assets/sys-assets/hd1080/scheduler\_splash.pngKLwL2fBGK+V?  
Vcom.webos.app.tvguide방송 안내/usr/palm/applications/com.webos.app.tvguide/assets/sys-assets/hd1080/tvguide\_splash.pngKLwL2fA52XJKLwL2fA52XJKLwL2fAayzcKLwL2fAudPgKLwL2fBGK+V%com.webos.launcher.recentsitems:1



# Compare LG with Samsung Smart TV's Digital Evidences

# Compare LG with Samsung Smart TV's Digital Evidences

	LG Smart TV		Samsung Smart TV	
	Our research	I.Sutherland [2]	H.S.Kang [3]	A.Boztas [1]
Issue Year	-	2014	2014	2015
Published	-	Australian digital forensics confer	KIISC*	Digital Investigation
Target	43UH6810	42LS570T-ZB, 55LA740V	UN46ES8000	UE40F7000SLXXN
TV's Release Year	2016	2012, 2013	2012	2013
OS	webOS 3.0	webOS 2.0	Proprietary OS	Proprietary OS
Data Acquisition Method	Software Vulnerability (1-day vuln)	Failed to acquire data	Software Vulnerability (1-day vuln)	Software Vulnerability (1-day vuln)
Data Analysis Main Procedure	(1) Disk Imaging (2) Diffing	Using only TV's functions(config menu, app info)	(1) Disk Imaging (2) Diffing	(It's guessed in the same way as us)

\*KIISC : Korea Institute of Information Security & Cryptology

# Compare LG with Samsung Smart TV's Digital Evidences

	LG Smart TV	Samsung Smart TV	
	Our research	H.S.Kang [3]	A.Boztas [1]
Issue Year	-	2014	2015
Published	-	KIISC*	Digital Investigation
Target	43UH6810	UN46ES8000	UE40F7000SLXXN
TV's Release Year	2016	2012	2013
OS	webOS 3.0	Proprietary OS	Proprietary OS
Data Acquisition Method	Software Vulnerability (1-day vuln)	Software Vulnerability (1-day vuln)	Software Vulnerability (1-day vuln)
Data Analysis Main Procedure	(1) Disk Imaging (2) Diffing	(1) Disk Imaging (2) Diffing	(It's guessed in the same way as us)

\*KIISC : Korea Institute of Information Security & Cryptology

# Compare LG with Samsung Smart TV's Digital Evidences

## User's Actions about features of TV

O : Discover the user's action on the TV

X : Not discover user's action or not exist on the TV

User's Action	LG Smart TV	Samsung Smart TV	
	Our research	H.S.Kang [3]	A.Boztas [1]
Last TV On Time	O	O	X
TV Channel List	O	O	O
External Storage Usage History	O	O	O

# Compare LG with Samsung Smart TV's Digital Evidences

## User's Actions about **applications**

O : Discover the user's action on the TV

X : Not discover user's action or not exist on the TV

User's Action	LG Smart TV	Samsung Smart TV	
	Our research	H.S.Kang [3]	A.Boztas [1]
Installed App Information	O	O	O
Internet History	O	O	O
Recently Service Usage History	O	O	O
Checking captured images	O	X (There's no capture func)	X (There's no capture func)

# Compare LG with Samsung Smart TV's Digital Evidences

## User's Actions about **system configuration**

O : Discover the user's action on the TV

X : Not discover user's action or not exist on the TV

User's Action	LG Smart TV	Samsung Smart TV	
	Our research	H.S.Kang [3]	A.Boztas [1]
Connected Wifi Information	O	O	X



# Compare LG with Samsung Smart TV's Digital Evidences

## User's Actions that exists for each Smart TV only

O : Discover the user's action on the TV

X : Not discover user's action or not exist on the TV

User's Action	LG Smart TV	Samsung Smart TV	
	Our research	H.S.Kang [3]	A.Boztas [1]
TV ON/OFF Reservation	O	X	X
Hardware Connection Information	O	X	X
Last time app opened	O	X	X
App Install History	O	X	X
Latest Watched TV Channel	X	O	X
Camera Usage	X (There's no camera)	O	X
Log policy configuration file	X	O	X
Request information In the cloud app	X (There's no cloud app)	X (Maybe there's no cloud app)	O

# Conclusion

# Conclusion

- Data Acquisition by obtaining root privilege
- Analyze data pre-imaging, testing, and post-Imaging comparisons
  - Features of TV : 5 user's actions
  - Pre-installed applications : 6 user's actions
  - System configuration : 1 user's action
- Comparison of LG and Samsung Smart TV
  - Because physical methods are laborious, data acquisition in a logical way
  - The large classification of user's actions is similar
  - User's Actions have different depths
    - Physical characteristics of Smart TV, such as camera presence
    - Similar functionalities of are implemented differently

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# Q&A

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